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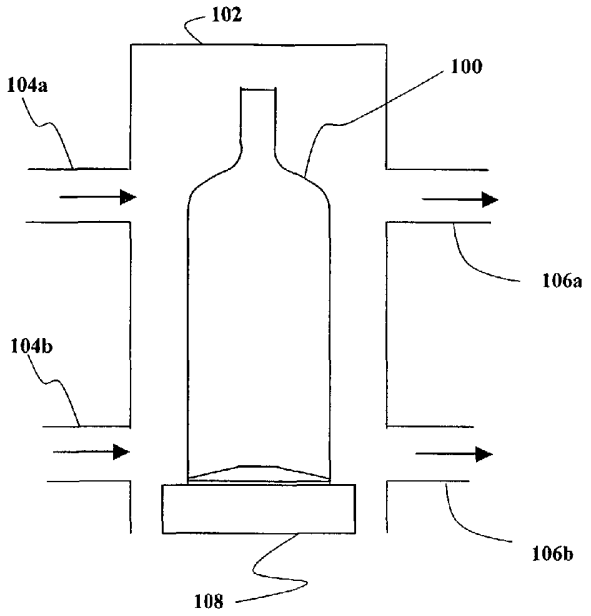
(54) **Title:** GLASS CONTAINER WITH A COATING




(57) **Abstract:** A glass container, such as a bottle (100) has a body with a side on which a coating layer has been deposited as from a gas phase. The coating material in the coating layer is concentrated in a contact zone, preferably in at least two zones (110, 112), at a foot of the vertical side and at location where the vertical side narrows towards a mouth of the bottle. The coating layer in an area (114) outside the contact zones or zones having an average thickness of less than 90% of thickness in said zone.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

Title: Glass container with a coating

The invention relates to a glass container with a coating applied to the bottle and a process for applying a coating to such a bottle.

An apparatus for coating bottles has been described in unpublished PCT patent application PCT/NL01/00916, by the same inventor as the present application and assigned to the same assignee. This application is incorporated herein by way of reference.

PCT/NL01/00916 provides for a coating process in which coating gas is applied to glass containers in a hot-end process. The coating gas is applied via separate slots which are vertically offset with respect to one another. Thus, the coating layer is concentrated in horizontal zones on the glass containers.

By concentrating the coating layer in horizontal zones only at the height on the glass containers where the coating is needed, for example to prevent scratching when different bottles come into contact with one another, a considerable saving can be made on coating material.

The present application is directed at bottles with protective coating and at coating processes, including coating processes in which the coating gas is applied concentrated in zones.

More particularly the invention relates to a glass container having a body with a side, usually vertical, on which a coating layer has been deposited from a gas phase, coating material in the coating layer being concentrated in a zone on the container side. When the side is vertical or concave (curving inward) the container has at least two zones, one at a foot of the vertical side and another at a location where the vertical side narrows towards a mouth of the bottle, the coating layer in an area on the container side between the zones having an average thickness of less than 90% of the thicknesses in said zones and preferably less than 80% (this area is sometines referred to herein as the "low coating thickness area"). It is characteristic of deposition of chemicals from a coating gas that the coating layer does not end abruptly at

the edge outside the zones, such as when the coating material would be applied by painting. When deposition from a gas is used the thickness profile drops off gradually outside the zones having maximum coating layer thickness.

It has been found that it is possible to make the average thickness in the area intermediate between the zones less than 90% and even less than 70% of the thickness in the zones. Preferably, average thickness in the area intermediate between the zones between 50% and 80% of the thickness in the zones. When the average thickness is reduced selectively in this area coating material is saved without significant loss of protection against scratching. The thickness in the area intermediate between the zones can vary significantly due to fluctuations, but the average thickness is less than 90% and can be less than 70% of the thickness in the zones.. Thickness fluctuations in prior art processes are typically at most 2CTU (Coating Thickness Units) in a layer of 30 CTU and then only locally, i.e. not on average. The preferred bottles don't have a minimum thickness in the intermediate area since the coating is not needed in the intermediate area to prevent scratching.

Preferably the coating layer on the bottles contains tin-oxide or titamnium applied with a hot-end coating process or chemical vapor deposition (CVD) process, but other materials and processes may be used as well. A typical thickness in the zones that is sufficient to provide protection without using an excess of coating material is 20-60 CTU.

These and other aspects of the bottle and process according to the invention will be described using the following figures.

Figure 1 shows a bottle in a coating tunnel

Figure 2 shows a graph of coating layer thickness along a bottle

Figure 3 shows a further graph of coating layer thickness

Figure 4 shows a bottle with convex sides in a coating tunnel

Figure 5 shows a bottle with convex sides and the graph of the coating layer thickness on the bottle.

Figures 1 and 4 show a cross-section of a bottle 100 in a coating tunnel 102. Coating tunnel 102 has openings 104a,b, 106a,b in its vertical side walls for supply and extraction of coating gas. A conveyor 108 is provided within coating tunnel 102. Bottle 100 is shown placed on conveyor 108. Coating tunnel 102 and conveyor 108 extend in a longitudinal (at least partly horizontal) direction transverse to the cross section shown in figure 1. Openings 104a,b, 106a,b are present at a two predetermined heights, which can be adjustable,relative to bottle 100, in a first zone or strip extending upward substantially from the bottom of bottle 100 and in a second zone or strip substantially around the height of the neck of bottle 100, where the body of bottle 100 starts narrowing towards its mouth. Openings 104a,b, 106a,b extend in the longitudinal direction at the predetermined heights, as a band of openings with mouths of any shape, such as circular, rectangular or elongated rounded shapes, or as one or more openings with an elongated mouth with a longest diameter extending in the longitudinal direction. Although openings 104,a,b, 106a,b are shown flush with the side walls, it will be understood that openings 104a,b, 106a,b may in fact be part of an extension that extends into coating tunnel 102 from the planes of the side walls. In Figure 4, the vertical height of openings 104a and 106a have been adjusted to accommodate the shape of a bottle having convex sides while openings 104b and 106b have been blocked so that the coating gas is directed to produce one coating zone applied on the bottle covering the apex area of the convex side and two low coating thickness areas are produced on the bottle above and below the coating zone at the apex as shown in the coating thickness graph in Figure 5.

Openings 104a,b, 106a,b are coupled to a supply unit (not shown) for supplying coating gas through the openings 104a,b and to a receiving unit (not shown) e.g. a pump for removing coating gas from coating tunnel 102 through

openings 106a,b. Preferably, coating gas is recirculated from the receiving unit to the supply unit. At each height one of the openings 104a,b in one of the side walls in coating tunnel 102 is coupled to a supply unit and the opposite opening at the same height in the opposite side wall is coupled to the pump. Successive openings in the same side wall may be coupled in a spatially alternating fashion to the supply unit and the pump, in order to deposit similar amounts of coating material in zones at the same height on opposite sides of bottle 100 and even a single opening may be coupled to the supply unit and the pump in a temporally alternating fashion.

In operation conveyor 108 transports a series of bottles though coating tunnel 102 in the longitudinal direction. During transport coating gas is supplied into coating tunnel from openings 104a,b in the vertical side walls of coating tunnel. Chemicals from the coating gas attach to the bottles 100 and a remainder of the coating gas is pumped out of coating tunnel through openings 106a,b in the side walls opposite to the openings 104a,b through which the coating gas is supplied. The chemicals that are thus deposited on a bottle 100 form a coating layer on as least part of bottle 100. In a preferred example Tin Oxide is deposited on bottle 100 from the coating gas, while the bottle is hot, for example at a temperature of around 600 degrees Celsius, but it will be understood that other chemical materials or combinations thereof and other temperatures may be used.

As a consequence of the fact that coating gas is supplied to coating tunnel 102 only through openings at specific height range such as two non-overlapping height ranges in Figure 1 and one height range in Figure 4 but two low coating zones above and below the coating zone defined by the height of opening 104a, the coating layer is concentrated in zones on bottle 100 at these height ranges. However, it is characteristic of deposition chemicals from a coating gas that the coating layer does not end abruptly at the edge outside the zones, such as when the coating material would be applied by painting.

When deposition from a gas is used the thickness profile drops off gradually outside the zones with maximum coating layer thickness.

Figures 2 and 5 show a graph of a profile of the coating layer thickness "t" as a function of height "h" along bottle 100, next top a bottle 100_ substantially at the heights where the corresponding thicknesses occur on bottle 100. In Figure 2, the profile has two zones S1, S2 of maximum thickness 110, 112, separated by an area A in which the thickness reaches a minimum 114. In the area A the thickness is generally everywhere smaller than in zones S1, S2. In fact in an area that covers a majority of the distance between the zones S1, S2 the average thickness is more than a certain percentage of for example 10% below the average thickness in zones S1, S2. Also on average the thickness in the area A is below the thickness everywhere in zones S1, S2.

The coating layer protects bottle 100 against damage, such as scratching though contact with other bottles. For this purpose, the coating layer preferably has at least a minimum thickness $t_0$ in a range of for example 20-60 CTU (Coating Thickness Units) and more preferably 40 CTU on the side of its body in the area where contact between two adjacent bottles is likely to cause scratching. For bottles having vertical or concave sides, the coating zones are near the bottom and near the location where the body begins to narrow towards its mouth. For bottles having convex sides as shown in Figure 5, the coating zone is at the apex of the convex side with low coating thickness areas above and below the coating zone at the apex. In Figure 1, by using openings 104a,b in coating tunnel 102 that extend only over two limited, non-overlapping ranges of heights, a coating layer with such a minimum thickness can be realized in zones S1, S2 at these heights, with thickness that drops off in an area A that covers substantially all of the side of the body between these zones S1, S2. When the average thickness in said area A is less than the thickness in the zones S1,S2 less coating material is expended on bottle 100 than if the coating layer on bottle 100 would have a substantially uniform thickness. In the latter case, the required amount of coating material would be

roughly proportional to the height of the bottle, whereas the required amount of coating material is substantially independent of the height of the bottle when the coating material is concentrated in zones S1, S2 with a gradual drop-off in the intermediate area A.

In order to minimize waste due to coating in area A, the openings 104a, and 104b (if used), from which coating gas is supplied are preferably as close as possible to the part of coating tunnel 102 through which conveyor 108 transports bottle 100. This permits a relatively sharp drop-off of the thickness " t" outside zones S1, S2. However, in order to prevent damage to the bottles due to collisions with the part of the side wall near the openings at least some distance, of for example 1 -5 cm, and preferably 2.5-3.5 cm is preferably maintained between the edge of openings 104a,b and bottle 100. In general it is preferred that this distance is less than twice the vertical extent of the openings, and preferably not more than substantially the vertical extent. This will result in some spreading of the coating layer, so that apart from the zones S1, S2 in which the coating layer has the minimum required thickness $t_0$, some coating material is also present on bottle 100 outside these zones, S1,S2.

In addition it has been found that it is desirable to configure the coating tunnel so that some turbulence occurs in the coating gas at least at the mouth of the openings, rather than laminar flow. This increases the speed with which the coating layer grows during processing. This turbulence can be generated by an appropriate combination of supply flow strength of the coating gas and the geometry of the openings. Of course, turbulence will also contribute to deposition of some unneeded coating material outside zones S1, S2, but coating material may nevertheless be saved due to less losses owing to the increased deposition speed. Furthermore, the openings 106a,b through which the coating gas is removed from coating tunnel 102 are preferably located at the same height as the openings 104a,b through which the coating gas is supplied and opposite these openings. This has the effect that the flow of coating gas spreads minimally over different heights, which leads to a sharper drop-off of

the thickness profile. However, it will be understood that some saving is already realized when the openings 106a,b through which the coating gas is removed are not opposite the openings 104a,b through which the coating gas is supplied and/or do not have the same vertical extent or shape.

It has been found that under laboratory conditions a minimum 114 of one tenth of the thickness at the maxima 110, 112 is possible, which leads to considerable savings. As a rule the ratio between minimum 114 and maxima 110, 112 will increase when bottle 100 becomes less high, since substantially the same amount of coating material is needed for bottles 100 with different height, because the width of maxima 100, 112 does not generally depend on the height of the bottle 100.

Figure 3 shows the graph of a profile of the thickness of the coating layer on a bottle that is less high than the bottle of figure 1 and 2. It should be noted that the ratio between the thickness at the minimum and at the maxima is higher than in figure 2.

However, any bottle in which coating material is concentrated in one or two zones that corresponds to the portions of the bottle sides where contact between two adjacent bottles is likely to cause scratching is advantageously less expensive to make than a bottle 100 with a coating layer with substantially uniform thickness. This happens when the average thickness of the coating layer in the area A is less than the minimum thickness $t_0$ in the zones S1, S2, or the average thickness in the zones S1, S2. When the average thickness in the area A between zones is more than 2 CTU less than the minimum thickness $t_0$ in the zones S1, S2 or the average thickness in the zones S1, S2, a saving is already realized. In practice bottles 100 can easily be realized on which the average thickness in area A and in any case the height at the minimum 114 is less than 0.9 times the minimum thickness $t_0$ in the zones S1, S2, and preferably less than 80% and most preferred less than half the minimum thickness $t_0$ in the zones S1, S2 or the average thickness in the zones S1, S2. This results in correspondingly greater savings. Likewise, a

bottle having convex sides as shown in Figure 5 can be produced with considerable savings in coating chemicals since the thickness in the coating zone covering the apex of the convex side is at the desired thickness in the region that corresponds to the portion of the bottle sidewall where contact between two adjacent bottles is likely to cause scratching.

## Claims

1. A glass container having a body on which a coating layer has been deposited from a gas phase, coating material in the coating layer being concentrated in a contact zone of the glass container, the contact zone extending over a minority of a side of the glass container, the coating layer in a remaining area on said side of the glass container having an average thickness of less than 90% of any thickness in said zone.

2. A glass container according to Claim 1 said side being a vertical side or a concave side of the body, the coating material in the coating layer being concentrated in at least two zones, at a foot of the side and at location where the side narrows towards a mouth of the glass container, the coating layer in the area on the side between the zones having an average thickness of less than 90% of thicknesses in said zones.

3. A glass container according to Claim 2, wherein said area covers substantially all of the vertical side between said zones.

4. A glass container according to Claim 1, wherein the coating layer comprises tin oxide and/or titatium oxide.

5. A glass container according to Claim 1, wherein the coating layer has a thickness in a range of 20-60CTU in the zone.

6. A glass container having a body with a vertical side, on which a scratch resistant coating layer has been deposited, coating material in the coating layer being concentrated in at least two zones, at a foot of the vertical side and at location where the vertical side narrows towards a mouth of the glass container, the coating layer in an area on the vertical side between the zones having an average thickness of less than 90% of thicknesses in said zones.

7. A glass container according to Claim 6, wherein the coating layer in the area on the vertical side between the zones has an average thickness of 80% or less of the thicknesses in said zones.

8. A glass container having a body with a concave side, on which a scratch resistant coating layer has been deposited, coating material in the coating layer being concentrated in at least two zones, at a foot of the concave side and at location where the side narrows towards a mouth of the glass container, the coating layer in an area on the concave side between the zones having an average thickness of less than 90% of average thicknesses in said zones.

9. The glass container of claim 8 wherein the coating layer in the zones has a thickness of from 20 to 40 CTU and the coating layer in the area on the concave side between the zones has an average thickness of 80% or less of the thicknesses in said zones

10. A glass container having a body with a vertical or concave side, on which a coating layer has been deposited from a gas phase, coating material in the coating layer being concentrated in at least two zones, at a foot of the side and at location where the side narrows towards a mouth of the glass container, the coating layer in an area on the vertical side between the zones, which area covers a major part of the distance between the zones, being everywhere in said area less than 90% of thicknesses in said zones.

11. A glass container having a body with a convex side, on which a coating layer has been deposited from a gas phase, coating material in the coating layer being concentrated in a zone covering the apex of the convex side, and the coating layer in the areas above and below the apex on the convex side having an average coating thickness of less than 90% of the average thickness in said zone.

12. The glass container of claim 11 wherein the coating layer in the areas above and below the apex on the convex side having an average coating thickness of less than 80% of average thickness in said zone.

13. A glass container having a body with a convex side, on which a scratch resistant coating layer has been deposited, coating material in the coating layer being concentrated in a zone covering the apex of the convex side, and the coating layer in the areas above and below the apex on the convex side having an average coating thickness of less than 90% of the average thickness in said zone.

14. The glass container of claim 13 wherein the coating layer in the areas above and below the apex on the convex side having an average coating thickness of less than 80% of average thickness in said zone.

15. A process of coating a glass container, the process comprising

- turbulently supplying coating gas selectively at least two heights relative to the glass container;
- exposing the glass container to said gas for a predetermined time interval.

16. A process according to claim 15, wherein said coating gas is supplied to an opening with a vertical size less than half a height of the glass container, the glass container being transported past the opening at a distance that is less than twice the vertical size.

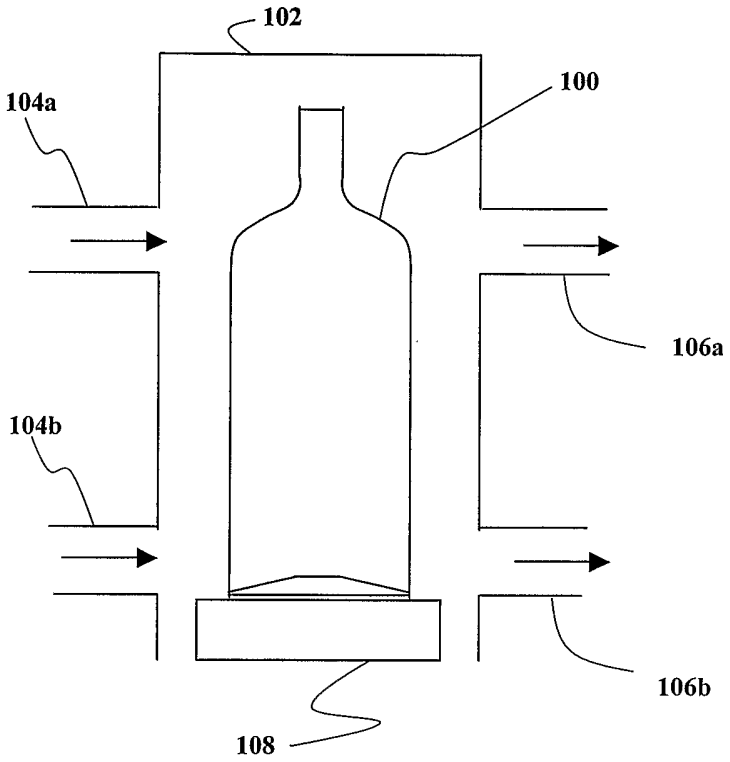


Fig. 1

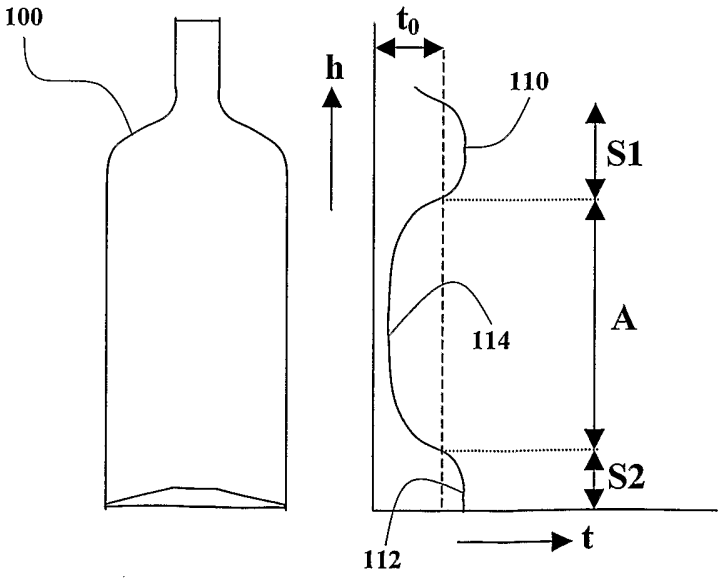


Fig. 2

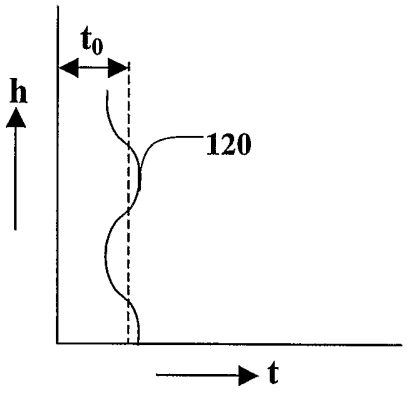


Fig. 3

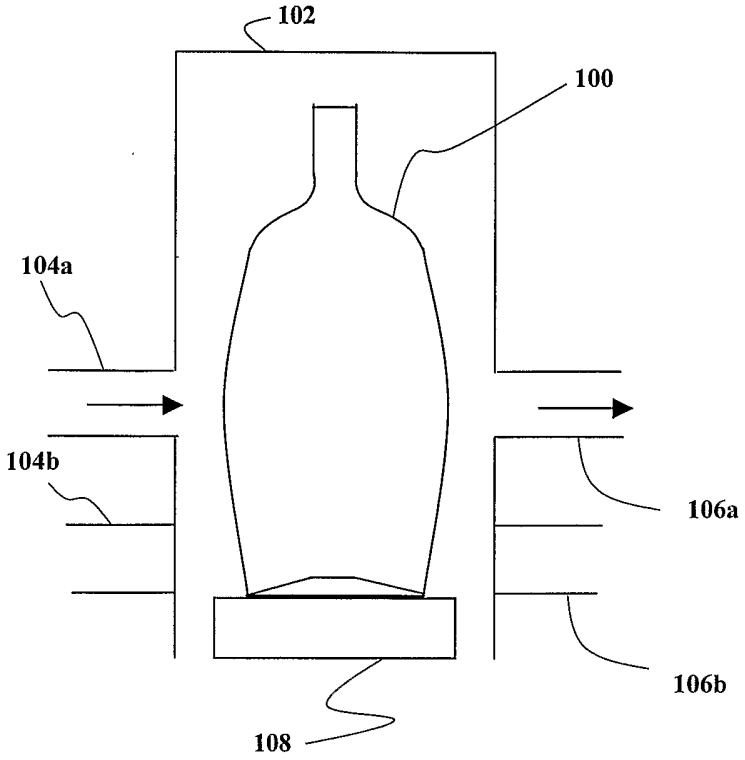


Fig. 4

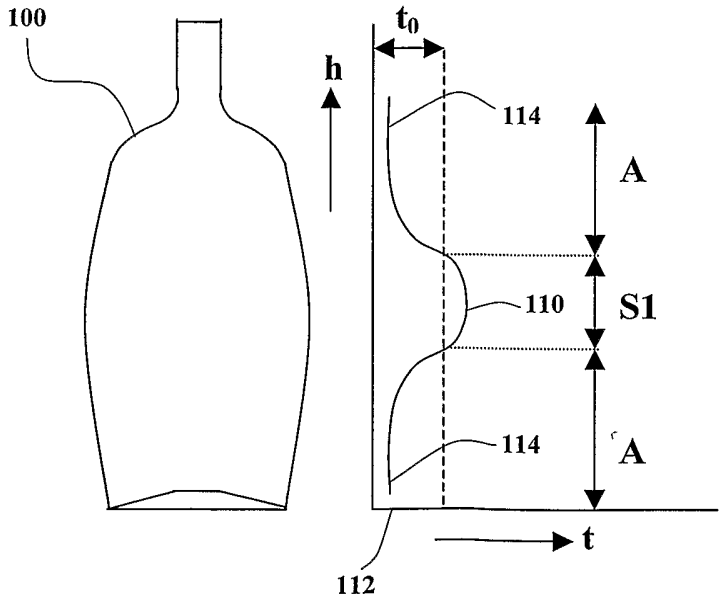


Fig. 5

# INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C03C17/00 B65D23/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C03C B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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|---|---|
| 18 February 2003 | 26/02/2003 |

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| European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Balz, O |

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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